How to read a research paper.

Later in the semester, we will talk about how to *write* a research paper. To begin the course, however, we consider how to *read* a research paper. This discussion presupposes that you have a good reason to carefully read a research paper – for example, the fact that I assign a paper is (probably) a good reason for you to read it. You may also need to carefully read a paper if you are asked to review it, or if it is relevant to your own research. We might also later discuss how to *skim* a paper, so that you can decide whether a paper is worth a careful reading.

When you read a research paper, your goal is to understand the scientific contributions the authors are making. This is not an easy task.[1] It may require going over the paper several times. Expect to spend **several hours** to read a paper.

Here are some initial guidelines for how to read a paper:

- Read *critically*: Reading a research paper must be a critical process. You should not assume that the authors are always correct. Instead, be suspicious.

  Critical reading involves asking appropriate questions. If the authors attempt to solve a problem, are they solving the right problem? Are there simple solutions the authors do not seem to have considered? What are the limitations of the solution (including limitations the authors might not have noticed or clearly admitted)?

  Are the assumptions the authors make reasonable? Is the logic of the paper clear and justifiable, given the assumptions, or is there a flaw in the reasoning?

  If the authors present data, did they gather the right data to substantiate their argument, and did they appear to gather it in the correct manner? Did they interpret the data in a reasonable manner? Would other data be more compelling?

- Read *creatively*: Reading a paper critically is easy, in that it is always easier to tear something down than to build it up. Reading creatively involves harder, more positive thinking.

  What are the good ideas in this paper? Do these ideas have other applications or extensions that the authors might not have thought of? Can they be generalized further? Are there possible improvements that might make important practical differences? If you were going to start doing research from this paper, what would be the next thing you would do?

- Make notes as you read the paper:

  Many people cover the margins of their copies of papers with notes. Use whatever style you prefer. If you have questions or criticisms, write them down so you do not forget them. Underline key points the authors make. Mark the data that is most important or that appears questionable. Such efforts help the first time you read a paper and pay big dividends when you have to re-read a paper after several months.

[1] It would be easier if more research papers were well written... but again, we will discuss writing later on.

- After the first read-through, try to summarize the paper in one or two sentences.

  Almost all good research papers try to provide an answer a specific question. (Sometimes the question is a natural one that people specifically set out to answer; sometimes a good idea just ends up answering a worthwhile question.) If you can succinctly describe a paper, you have probably recognized the question the authors started with with and the answer they provide. Once you have focused on the main idea, you can go back and try to outline the paper to gain insight into more specific details. Indeed, if summarizing the paper in one or two sentences is easy, go back and try to deepen your outline by summarizing the three or four most important subpoints of the main idea.

- If possible, compare the paper to other works.

  Summarizing the paper is one way to try to determine the scientific contribution of a paper. But to really guage the scientific merit, you must compare the paper to other works in the area. Are the ideas really novel, or have they appeared before? (Of course we do not expect you to be experts and know the areas ahead of time in this class!)

  It is worth mentioning that scientific contributions can take on many forms. Some papers offer new ideas; others implement ideas, and show how they work; others bring previous ideas together and unite them under a novel framework. Knowing other work in the area can help you to determine which sort of contribution a paper is actually making.

For this class, I will often ask you to provide a short, one page review of a paper. Although this may sound like a simple assignment, I expect that it will take a significant amount of time, especially in the beginning. (Remember, I am expecting it to take several hours just to read the paper!) Keeping the above in mind as you read the paper should make the process easier.

Your one page review should include the following:

- a one or two sentence summary of the paper.
- a deeper, more extensive outline of the main points of the paper, including for example assumptions made, arguments presented, data analyzed, and conclusions drawn.
- any limitations or extensions you see for the ideas in the paper.
- your opinion of the paper; primarily, the quality of the ideas and its potential impact.